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Monetary Policy Autonomy in a Credible Target Zone

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This paper examines the trade-off between exchange rate stability and monetary autonomy for a target zone. Using the guilder-mark target zone in the pre-EMU period as a case study, we empirically estimate how much policy discretion the Dutch central bank still enjoyed and how much had been ceded to the German central bank. The sum of these two measures is an estimate of the policy autonomy under a free float. We find that the narrow guilder-mark target zone still permitted a modest degree of policy independence. This result suggests that intermediate exchange rate regimes may offer an attractive trade-off compared to the corner solutions (free float and monetary union), which is consistent with the 'fear of floating' phenomenon.

JEL Classification Numbers: E52, F33, F41, F42.

Keywords: exchange rate regime, monetary union, monetary autonomy, fear of floating, trilemma.

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1. Introduction

Standard international macroeconomic theory posits that economic policy makers are confronted by three desirable objectives, which cannot be achieved simultaneously (Obstfeld, Shambaugh and Taylor 2002). The three objectives are (1) exchange rate stability (which is good for relative price stabilization purposes), (2) perfect capital mobility (which is good for efficiency and flexibility purposes), and (3) monetary policy autonomy (which is good for output stabilization purposes). Policy makers can opt for perfect versions of two items of this list, but then have to completely give up on the third one. Intermediate regimes on all three dimensions are also possible. This fundamental trade-off is variously known in the literature as the trilemma or the inconsistent or impossible trinity/triangle. Using data spanning more than 130 years, Obstfeld, Shambaugh and Taylor (2002) present strong empirical support for the relevance of the trilemma over a broad range of countries, exchange rate regimes and degrees of international capital mobility.

As the trilemma acts as a constraint on macroeconomic policy choices, it is important to have an idea how stark the trade-offs are, especially inside the triangle (i.e. for intermediate regimes). After the financial crises of the 1990s many observers have suggested that intermediate exchange rate regimes are disappearing. Frankel, Schmukler and Servén (2001) use the notion of verifiability to argue that intermediate regimes suffer from more severe credibility problems than a corner solution. In this view, the rise of international capital mobility forces countries to choose either a hard peg (currency board, dollarization or full monetary union) or freely floating exchange rates. This suggests that an intermediate exchange rate regime, such as a target zone, is characterized by a particularly unfavorable trade-off. On the other hand, Calvo and Reinhart (2002) found that there is widespread ‘fear of floating’ and that intermediate exchange rate regimes predominate in practice. Countries that officially declare to have a free float often behave as if the regime is less flexible. This observation suggests that the trade-off is good for an intermediate regime, but bad in the free float corner of the triangle.

In the debate on the European Economic and Monetary Union (EMU), similar positions can be observed. Wyplosz (1997) argued that the complete abolition of capital controls in particular made the move to monetary union practically unavoidable. Obstfeld and Rogoff (1995) concluded that ‘there is little comfortable middle ground between floating rates and the adoption by countries of a common currency.’ On the other hand, many economists have pointed out that the euro area is not an optimum currency area and that the degree of asymmetry of economic shocks may be large. The complete loss of monetary autonomy implied by the transition from a target zone to EMU may therefore amount to a substantial cost in terms of macroeconomic stabilization capabilities (Feldstein 1997; Obstfeld 1998; OECD 1999).

This paper aims to contribute to the scant empirical literature on this topic by analyzing the case of the guilder-mark target zone in the years 1983–98. The guilder-mark peg constitutes an interesting experiment because it was maintained without interruption for many years on end. It is the only European target zone that existed long enough to permit an empirical analysis based on time series data.[1] From a theoretical point of view, a credible target zone still permits some interest rate flexibility, and thus some limited scope for discretionary monetary policy (Svensson 1994; Frankel, Schmukler and Servén 2001). During the period of the guilder-mark peg, the money market interest rate differential between the Netherlands and Germany varied between –61 and 165 basis points.[2] How much policy autonomy this represented is an interesting empirical question. Both Germany and the Netherlands joined EMU at the beginning of 1999. Since then the interest differential has been zero, because the introduction of the euro has created a single money market, and the Netherlands has no longer any monetary policy independence left.

Moreover, our methodology of measuring monetary policy autonomy differs from the approach taken in the literature, which mainly looks at the ability to maintain the local interest rate at a level that differs from the 'world' interest rate.[3] Employing a VAR methodology, we investigate to what extent domestic (Dutch) monetary policy shocks are able to explain movements in the key macroeconomic variables that policy makers care about (output and inflation). Using the same concept, we can also estimate how much monetary autonomy is ceded to the central bank of the dominant country (Germany) by maintaining the target zone. The sum of the two measures is a measure of the degree of monetary policy discretion under freely floating exchange rates.

The remainder of this paper is organized as follows. Section 2 goes into some methodological issues, Section 3 presents the empirical results and Section 4 concludes.

2. Methodological issues

Monetary policy discretion refers to the ability of a central bank to influence (with a substantial lag) key macroeconomic variables, such as inflation and economic growth, by varying policy interest rates. Within EMU, it is impossible for the Netherlands to change its money market interest rate relative to that of Germany (or other EMU participants). The degree of monetary autonomy is therefore zero. In

[1] The last change in the guilder/mark parity occurred on 21 March 1983 when the guilder was devalued by 2% against the Deutschmark. The exchange rate of the guilder vis-à-vis the Deutschmark has been kept within a very narrow band around the parity ever since. In fact, the actual band was much narrower than the official one of ±2.25%. The fact that the guilder-mark peg was the only one that did not come under attack during the ERM crises in 1992 and 1993 is testimony to the credibility of the fixed exchange rate commitment.

[2] The mean was 27 basis points and the standard deviation 61 basis points.

[3] See, among others, Frankel, Schmukler and Servén (2002), Fratzscher (2002), and Obstfeld, Shambaugh and Taylor (2002).

the period under consideration (1983–98), Dutch monetary policy was first and foremost aimed at maintaining a fixed guilder/mark exchange rate, using the money market interest rate as the main instrument.[4] But the regime of the guilder/mark peg still permitted a limited degree of interest rate flexibility, implying a certain degree of monetary autonomy. If this limited amount of monetary autonomy offered valuable opportunities for macroeconomic stabilization, one would expect a shock in the Dutch interest rate, which has to be consistent with the peg, to have the conventional effects on macroeconomic variables like output, credit and the price level. A contractionary monetary policy shock should be followed by a fall in these variables. Consequently, a natural measure of the degree of monetary policy autonomy is the percentage of the forecast error variance of real GDP and the price level that can be attributed to Dutch monetary policy shocks.

Following the empirical literature on the monetary transmission mechanism we use a Vector Autoregression (VAR) model to investigate the impact of monetary policy changes. We describe the Dutch economy by the following reduced-form VAR model,

(1) $$Z_t = A_1 Z_{t-1} + \ldots + A_p Z_{t-p} + u_t$$

where Z_t is a vector of variables observed at time t, and p is the maximum lag of the system. Z consists of seven variables (in the following order): the German consumer price index (CPI), the Dutch CPI, the German real GDP, the Dutch real GDP, the German money market interest rate, the deviation of the guilder/mark exchange rate from parity, and the Dutch-German money market interest rate differential. The disturbance vector u_t is assumed to be serially uncorrelated and to have covariance matrix V. Eq. (1) is a reduced form that can be thought of as being derived from the following structural model,

(2) $$Z_t = B_0 Z_t + B_1 Z_{t-1} + \ldots + B_p Z_{t-p} + e_t$$

where e_t is the vector of the underlying structural shocks that we want to identify. By construction, e_t has as covariance matrix the identity matrix. The reduced form disturbances u_t are thus related to the underlying structural disturbances e_t by

(3) $$u_t = [I - B_0]^{-1} e_t = A_0 e_t$$

[4] For an overview of Dutch monetary policy in the post-war period, see De Greef, Hilbers and Hoogduin (1998).

Eq. (1) is estimated by ordinary least squares, while A_0 is calculated from V using the conventional Cholesky decomposition. Hence, A_0 is a lower triangular matrix and u_t is assumed to be determined in a recursive fashion by e_t. This standard analytical set-up allows the calculation of impulse response functions (the reaction of one of the variables in Z_t to a change in one of the shocks in e_t) as well as the calculation of the variance decomposition for each variable in Z_t, which shows the percentage of the forecast error variance that can be attributed to the various structural shocks.

The structural disturbance associated with the German money market interest rate can be interpreted as the German monetary policy shock. Likewise, the structural disturbance associated with the Dutch-German money market interest rate differential can be interpreted as the Dutch monetary policy shock. Monetary policy shocks are of course unobservable variables, so we need some supportive evidence that such an interpretation is reasonable. For this reason, we examine the response of a number of macroeconomic variables to a shock in the Dutch-German interest rate differential. A contractionary domestic monetary policy shock should after some time be followed by lower output and a lower price level (among other things). If such patterns are indeed observed, this could be viewed as circumstantial evidence that the shock can plausibly be considered as a monetary policy shock by the Dutch central bank. We follow a similar procedure to ascertain that disturbances to the German interest rate can plausibly be interpreted as a policy shock by the Deutsche Bundesbank.[5]

We measure monetary policy independence along two dimensions, namely the ability to influence domestic output and inflation by monetary policy actions. Within the VAR framework, the natural measure of the degree of monetary policy autonomy of Dutch policy makers within the target zone is the percentage of the forecast error variances of output and the price level respectively that can be attributed to the Dutch monetary policy shock. This degree of policy independence was given up by the Netherlands when it entered into the European monetary union. By committing to and maintaining a target zone against the mark the Dutch economy became susceptible to policy actions by the Deutsche Bundesbank. Consequently, the degree of monetary policy autonomy that Dutch policy makers lost when they agreed to the target zone can be measured by the percentage of the forecast error variances of output and the price level respectively that can be attributed to the German monetary policy shock. Under perfect floating the Dutch monetary authorities enjoy, at least in theory, full independence, as the economy can be shielded from German policy moves. The degree of monetary

[5] The first four elements of the structural disturbance vector e can generally speaking be interpreted as a mixture of supply and demand shocks, whose interpretation is not interesting for the purpose of this study. The sixth element of the vector e is an exchange rate shock, which could conceivably be interpreted as a monetary policy shock as well. However, an impulse response analysis shows that a weakening of the guilder is followed by a hike in the Dutch interest rate. This reaction demonstrates that the weakening is not intended by the Dutch central bank. Consequently, we interpret the exchange rate shock as a shock that has to be countered by the Dutch central bank under the obligations of the target zone.

policy autonomy in a free float can therefore be measured by the percentages of the forecast error variances of output and the price level respectively that can be attributed to the Dutch and German monetary policy shocks.

As the disturbances are orthogonalized on the basis of the Cholesky decomposition, the ordering of the variables in the VAR determines the pattern of recursivity, and thus may be of crucial importance for the identification of the disturbances. The main identifying assumption in this paper is that changes in interest rates and exchange rates do not contemporaneously affect real variables and prices. The price level and output therefore appear at the top of the ordering, with German variables preceding their Dutch counterparts.[6] The German interest rate is coming next, allowing both the guilder/mark exchange rate and the Dutch central bank to react contemporaneously to a German monetary policy move. Changes in policy rates by the Bundesbank were always followed immediately by the Dutch central bank. Given the overriding importance of the exchange rate objective, the guilder/mark exchange rate has to precede the interest rate differential, which is the Dutch policy variable. This assumption permits a contemporaneous response by the Dutch central bank to a weakening of the guilder. This too is an accurate reflection of actual practice as the Dutch monetary authorities tended to hike short-term interest rates immediately after a weakening of the guilder in an aggressive defense of the peg (De Greef, Hilbers and Hoogduin 1998).

The empirical analysis is based on quarterly data for the period 1983.III–97.IV (58 quarters).[7] The maximum lag p is set at 3.[8] The time series we use are non-stationary (integrated of order one).[9] This brings up the question whether we should difference the data. Employing differenced data has the drawback of neglecting potentially important long-run relationships among the time series involved. Faust and Leeper (1997) argue that – in part because the number of cointegrating relationships is unknown and thus has to be estimated – imposing long-run restrictions will not necessarily improve

[6] Putting prices in front of output reflects the well-known fact that the price level is stickier than output in the short run. However, interchanging prices and output in the ordering does not affect the results materially.
[7] All data series are seasonally adjusted. The sample ends in 1997 because 1998 was a transitional year during which perfect convergence had to be achieved ahead of the start of EMU on January 1, 1999. Data sources are the *Quarterly National Accounts* published by the OECD (real GDP), *International Financial Statistics* published by the IMF (money market rates, CPI, foreign assets and liabilities of banks) and De Nederlandsche Bank (all other data).
[8] Optimal lag length tests indicate a maximum lag of 3 or 4. Given the relatively short sample period, we set p equal to 3 for degrees-of-freedom considerations. However, fixing p at 4, which is often done in empirical papers using quarterly data, does not change the results materially. Moreover, to achieve a further increase in degrees of freedom, we also tried to put zero-restrictions on the lagged Dutch variables in the equations for German variables in the VAR model. This search produced 27 zero-restrictions, which are easily accepted by the data. The associated $?^2(27)$-statistic was only 17.94 (p-value 0.91). Lagged values of the Dutch price level and real GDP enter the equation for German real GDP and lagged values of the interest differential enter the equation for the German price level.
[9] The finding that the guilder/mark exchange rate is non-stationary is a little surprising, as a credible target zone implies a stationary exchange rate. It is probably due to the low power of unit root tests in short samples. It is

the reliability of structural inferences. Like a number of recent empirical papers on the monetary transmission mechanism, we have therefore chosen to refrain from imposing cointegration and to estimate unrestricted VAR models in levels.[10] Our approach still allows for the existence of cointegrating relationships, however.

3. Empirical results

This section first investigates how key macroeconomic variables respond in case of a positive German or Dutch interest rate shock. This analysis serves as a check whether the Cholesky identification scheme generates interest rate shocks that can reasonably be viewed as monetary policy shocks (as opposed to money demand shocks). The empirical evidence is presented in the form of graphs of the impulse response functions (IRF) of the key variables after a one-standard error shock to the Dutch or German money market interest rate. The IRFs are expressed as percentage points in deviation of the baseline path. The broken lines indicate one-standard error bands.[11] After discussing the IRFs, we calculate our measures of the degree of monetary policy discretion.

Figure 1 depicts the evolution of a positive shock in the German interest rate and its effects on the exchange rate, the Dutch-German interest rate differential, Dutch real GDP and the Dutch price level. The average German monetary policy shock is 27 basispoints and quite persistent. The guilder weakens versus the mark, which forces the Dutch central bank to raise interest rates as well. Initially, the Dutch interest rate increases by somewhat less than the German interest rate, but in the next quarter the ongoing weakness of the guilder leads to a further increase in the Dutch interest rate. The Dutch central bank maintains a slightly higher interest rate differential for a sustained period, which even extends beyond the period of weakness of the guilder, suggesting a cautious attitude on the part of the Netherlands Bank. The higher level of interest rates in Germany and the Netherlands puts downward pressure on Dutch output and price level developments. Dutch real GDP gradually contracts by around 0.20 percent in total over the next 2.5 years, and then starts a slow recovery.

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also interesting to note that the price level is not an I(2) variable, but an I(1) variable. Results of the unit root tests are available on request.

[10] See, for example, Christiano, Eichenbaum and Evans (1996), and Ramaswami and Sloek (1998). Hamilton (1994, Chapter 20.4) offers a discussion on the issue of 'to difference or not to difference.'

[11] Like Christiano, Eichenbaum and Evans (1996), we show one-standard error bands. We do this for presentational reasons, as displaying two-error bands would double the range of Y-axis and thus "flatten" the IRF. As is well-known, standard errors for dynamic inferences based on VARs are in general relatively large (see Hamilton 1994, chapter 11.7). This is likely to be even more true in our case, where the time-span of the data is relatively short. The purpose of the plots is to concisely present the average response and a standard measure of the uncertainty surrounding it. The bands should not be interpreted as confidence intervals associated with conventional levels of statistical significance.

Similarly, the Dutch Consumer Price Index gradually falls by 0.15 percent in 3 years time, and starts returning to the baseline thereafter.[12]

Figure 2 shows the macroeconomic effects of a contractionary shock in the Dutch-German money market interest rate differential. The typical shock is only 15 basis points and short-lived, illustrating the limited room for independent interest rate movements in the Netherlands.The rise in the money market rate is followed by a temporary and small appreciation of the guilder. The interest rate shock is thus consistent with a credible guilder/mark peg. Output gradually declines for six quarters to 0.15% below the baseline, before turning around. Output is close to the baseline again after about four years. Prices are rather sticky, as the price level is hardly affected for two quarters, before it gradually falls to 0.15% below the baseline. After bottoming out the price level slowly starts to climb back again.[13] Applying the methodology developed by Christiano, Eichenbaum and Evans (1996), we have also estimated the response of banking sector variables (such as loans and holdings of securities). These results show that a higher interest rate differential is followed by a contraction of Dutch banks' balance sheets, which is consistent with the literature on the credit channel and the financial accelerator. These additional IRFs are discussed in the appendix.

All in all, the empirical results reported in Figures 1 and 2 and the appendix indicate that positive shocks to the Dutch and German interest rates can indeed plausibly be interpreted as contractionary monetary policy shocks. Table 1 reports the contribution of both interest rate shocks to the forecast error variance of Dutch real GDP and the Dutch Consumer Price Index for various horizons. Depending on the forecast horizon, Dutch policy shocks account for 5 to 8% of the forecast error variance of real GDP. For the forecast error variance of the price level it is 10 to as much as 19%. These numbers suggest a small but non-negligible scope for macroeconomic stabilization by the Dutch central bank. German policy shocks account for 11 to 16% of the forecast error variance of Dutch real GDP and 7 to 16% of the forecast error variance of the Dutch CPI. The contributions of the German shocks can be seen as a quantitative measure of the monetary autonomy that has been ceded to the Bundesbank as a consequence of the target zone.

Dutch policy shocks contribute more to the forecast error variance of prices is than of output, both in absolute terms and relative to German policy shocks. This suggests that a country in a target zone may enjoy a greater degree of discretion with respect to inflation than with respect to its output

[12] Our results are broadly in line with those of Garretsen and Swank (1998) who studied the effects of German policy shocks on the Dutch economy in the period 1979–93.

[13] Interestingly, for both policy shocks we find no evidence of the 'exchange rate puzzle' or the 'price puzzle'. The 'exchange rate puzzle' refers to the finding that the exchange rate depreciates after a monetary policy tightening. See Kumah (1996) and Smets (1997) for a discussion. The 'price puzzle' refers to the finding that the price level rises following a monetary policy tightening. See Sims (1992) and Christiano, Eichenbaum and Evans (1996) for a discussion.

developments. This may be related to the behavior of wages. As Figure 3 shows, Dutch private sector wages are much more responsive to Dutch policy shocks than German ones.[14] Domestic wages are very slow to react to a German policy move. It takes more than a year before wages start falling below the baseline. After 3½ years they reach their lowest point at 0.18% below the baseline. By contrast, Dutch wages quickly respond to Dutch monetary policy actions. After two years wages are 0.14% lower, despite the fact that the typical Dutch shock is much smaller and less persistent than its German counterpart. This remarkable finding may be explained by 'monetary policy by speech'. If the Dutch central bank is worried about domestic inflationary pressures, it will of course raise interest rates as far as the target zone permits. But at the same time it will also start to publicly stress the need for wage moderation by the private sector, citing concerns about inflation and loss of price competitiveness by Dutch exporters. Other Dutch policy makers are likely to do the same. Influencing the public debate on the need for an appropriate wage increase constitutes a separate channel of monetary policy through which the effects of the interest rate shock are magnified.[15] By contrast, although policy actions by the Bundesbank will be followed suit by the Dutch central bank due to the target zone, they are less likely to be amplified by this kind of monetary policy by speech, because German policy steps reflect concerns about German inflation.

Adding the contributions of the Dutch and German policy shocks together, we get an indication how large the degree of monetary policy independence may be in terms of macroeconomic stabilization capabilities in case of freely floating exchange rates. At a horizon of 2 to 5 years the degree of monetary policy autonomy with respect to output stabilization is approximately 20%. The degree of policy discretion with respect to inflationary developments is larger, 25 to 35%. The scope for macroeconomic stabilization is smaller than that enjoyed by the Federal Reserve. Using the same methodology as in this paper, Christiano, Eichenbaum and Evans (1996) report for the US that almost 30% of the forecast error variance of real GDP can be attributed to monetary policy shocks at the 6-year horizon.

Our results are consistent with the idea that (credible) intermediate exchange rate regimes may be characterized by a good trade-off, as is suggested by the 'fear of floating' phenomenon documented by Calvo and Reinhart (2002). By sacrificing a little exchange rate stability, the Netherlands was able to retain a significant part of its monetary policy independence. Even at the 5-year horizon, this

[14] To compute the IRFs in Figure 3 wages were added to the VAR model of eq. (1) as the third variable in de ordering.

[15] The institutional set-up of economic policy formation in the Netherlands (known as the 'Polder model') is characterized by trust-enhancing consultations among government, trade unions and employers' associations. As a consequence the three parties involved often strive for consensus on policy measures, including the desirable contractual wage rate increase. For example, in October 2003, the government, unions and employers agreed on a freeze of contractual nominal wages for 2004 and 2005. See Den Butter and Mosch (2003) for a description of the institutional features of the Dutch Polder model and the role of the central bank.

autonomy still amounted to one-fifth for output developments and one-third for inflationary developments. The free float regime thus appears to be relatively unattractive, as large gains in exchange rate stability can be achieved at the cost of limited losses of policy autonomy (even in case of perfect capital mobility). On the other hand, our results also mean that joining a monetary union from a situation of a narrow target zone entails a non-trivial sacrifice of macroeconomic stabilization opportunities.[16]

4. Concluding remarks

The paper analyzes the Dutch experience with the guilder-mark target zone in the pre-EMU era in order to shed light on the trade-off that policy makers face between exchange rate stability and monetary autonomy when capital is perfectly mobile across borders. A target zone is an intermediate exchange rate regime between two corners of the 'impossible triangle', namely monetary union on the one hand and freely floating exchange rates on the other hand. Since economic growth and inflation are the key macroeconomic variables policy makers are ultimately interested in, we measure the degree of monetary autonomy by the percentage of the forecast error variances of domestic output and inflation that can attributed to domestic monetary policy shocks. Within our framework, the degree of monetary autonomy that has been ceded to the dominant country (in our case Germany) can be calculated as the percentage of the forecast error variances that can attributed to foreign monetary policy shocks. The sum of the two measures gives an indication how large the degree of monetary independence would be in a regime of a completely free float.

We find that Dutch monetary policy shocks account for 5–8% and 10–20% of the forecast error variance of Dutch real GDP and the price level, respectively. Policy shocks by the Deutsche Bundesbank account for 11–16% of the forecast error variance of Dutch real GDP and 7–16% of that of the Dutch CPI. Consequently, the Netherlands enjoyed a modest degree of monetary autonomy in the years before it became a member of EMU. Our findings thus imply that joining the monetary union involved a non-trivial loss of macroeconomic stabilization opportunities for the Netherlands. Regarding the fundamental trade-off between exchange rate stability and monetary autonomy at a point inside the impossible triangle, our conclusion is that this trade-off was quite attractive in the case of the guilder-mark target zone. The sacrifice of a little exchange rate stability appears to have allowed the Netherlands to retain a significant part of its monetary policy independence. This finding may help explain why very few countries have a pure float as an exchange rate regime. As is often the case in economics, interior solutions seem to be optimal.

[16] Although monetary policy by speech is still possible inside a monetary union, it is likely to be less effective than in a target zone regime because it cannot be backed up by actions on interest rates.

The Dutch experience in the pre-EMU era may have particular relevance for those EU-member states that are currently outside EMU (Denmark, Sweden and the UK) and the Central and East European countries that will accede to the European Union in 2005, and will join EMU at a later stage. In order to join the monetary union the acceding countries have to fulfill, among other things, the exchange rate criterion spelled out in the Maastricht Treaty of 1992. This criterion says that EMU-candidates must maintain a stable exchange rate versus the euro for at least two years before they are allowed to join EMU. In practice they will have to adopt a narrow (±2.25% around the central rate) target zone within the framework of the European Rate Mechanism (the so-called ERM II) for at least two years. Our empirical results may provide some rough estimate of the loss of monetary policy discretion that may be associated with the adoption of the target zone, and later on, the euro.

The impending loss of monetary autonomy may be one of the reasons why voters in Denmark, Sweden and the United Kingdom remain so skeptical about joining EMU. Sweden and the UK have freely floating currencies, while Denmark even maintains, like the Netherlands prior to EMU, a narrow target zone versus the euro. A majority of British voters consistently opposes EMU membership in opinion polls. Danish voters rejected EMU membership in September 2000 in a referendum, despite a strong pro-euro campaign by the business and political establishment. Swedish voters did the same in September 2003. Tellingly, when asked in exit polls to list the issues that had mattered most, no-voters put national control of interest rates in third place, after democracy and sovereignty (*The Economist*, 20-26 September 2003, p. 33).

Appendix

This appendix presents the response to a Dutch interest rate shock by various banking sector variables, which propagate the shock through the economy. These IRFs provide additional evidence that the interest rate shock can be interpreted as a policy shock. The VAR system (1) consists of variables that represent either the beginning of the transmission process (interest rates and exchange rate) or the end of it (output and prices). As is well-known, the banking sector plays an important part in the monetary transmission mechanism. Ideally, one would like to include all transmission variables in a single unconstrained VAR system, estimate the model and then calculate the IRFs of all *Z*-variables simultaneously. Given the limited length of the available time series, this is clearly impossible. We therefore follow the intermediate strategy devised by Christiano, Eichenbaum and Evans (1996). For each transmission variable *X*, we calculate its IRF to a policy shock on the basis of a separate VAR model for which the vector *Z* contains *X* as an additional variable. The IRFs of the transmission variable *X* that are reported below are thus derived from different VAR models. They measure partial equilibrium effects in the sense that potential interactions among the transmission variables themselves, which an all-encompassing VAR system would accommodate, are neglected.[17] The variable *X* is the fifth element of *Z*, except in case of the mortgage interest rate, when it is ordered last (so that banks can react to policy moves contemporaneously).

Figure A1 presents the banking sector's response to a contractionary monetary policy shock. Banks increase their mortgage lending rates in the same quarter by approximately half of the money market rate increase. The central bank succeeds in shrinking the balance sheet of the banking system. Total banking assets quickly fall by 0.5% after one quarter, and start to increase after the third quarter. Despite alternative sources of funding, Dutch banks appear to be unable to fully shield their operations from monetary policy actions. The decline of total banking assets is accompanied by an adjustment of the composition of the portfolio. Foreign assets act as the main hedge against monetary tightening, as banks sharply reduce their foreign asset holdings in the short run. Dutch banks are major players in the European interbank market. Winding down positions in the international interbank market appears to be the cheapest way of adjusting the balance sheet quickly. Holdings of domestic securities initially stay put, and then decline rather steeply to 0.4% below the baseline. Banks protect their corporate loan portfolio. Loans to firms initially even increase a bit, which may reflect a temporary increase in short-term financing needs by firms due to higher inventories. After 5 quarters loans to firms are a comparatively modest 0.09% below the baseline, after which they recover to their initial value. Banks treat households and firms differently. Mortgage loans start to decline quickly, although in percentage

[17] As noted by Christiano, Eichenbaum and Evans (1996), a consequence of this approach is that the impulse is not exactly the same across the different VAR models, because the eighth *Z*-variable is different. The fact that

terms less than total assets. In the medium term mortgage lending fall by 0.15%. Like in the US and the UK, the housing market appears to play an important part in the transmission of monetary policy.

The IRFs in Figure A1 are consistent with the literature on the credit channel and the financial accelerator, which predicts that following a contractionary monetary policy shock, banks will at first seek to protect their loans by drawing down a buffer stock of assets, and will primarily cut loans to those agents that are more bank-dependent, such as households.[18] This finding may serve as further evidence that the Dutch interest rate shock has the properties of a monetary policy shock.

the impulse response functions of the seven common variables are similar across the models, suggests that this is not a serious problem in our case.

[18] See Bernanke and Gertler (1995) and Kashyap and Stein (1997) for an overview of this literature.

Table 1. Contribution of policy shocks to forecast error variance

Horizon		Real GDP	Price level
2 years	German shock	10.7	7.3
	Dutch shock	8.4	15.3
	Total	19.1	22.6
3 years	German shock	15.4	15.6
	Dutch shock	7.2	19.1
	Total	22.7	34.7
5 years	German shock	16.2	16.2
	Dutch shock	4.6	9.7
	Total	20.8	25.9

Figure 1. German policy shock and its effects on the Dutch economy

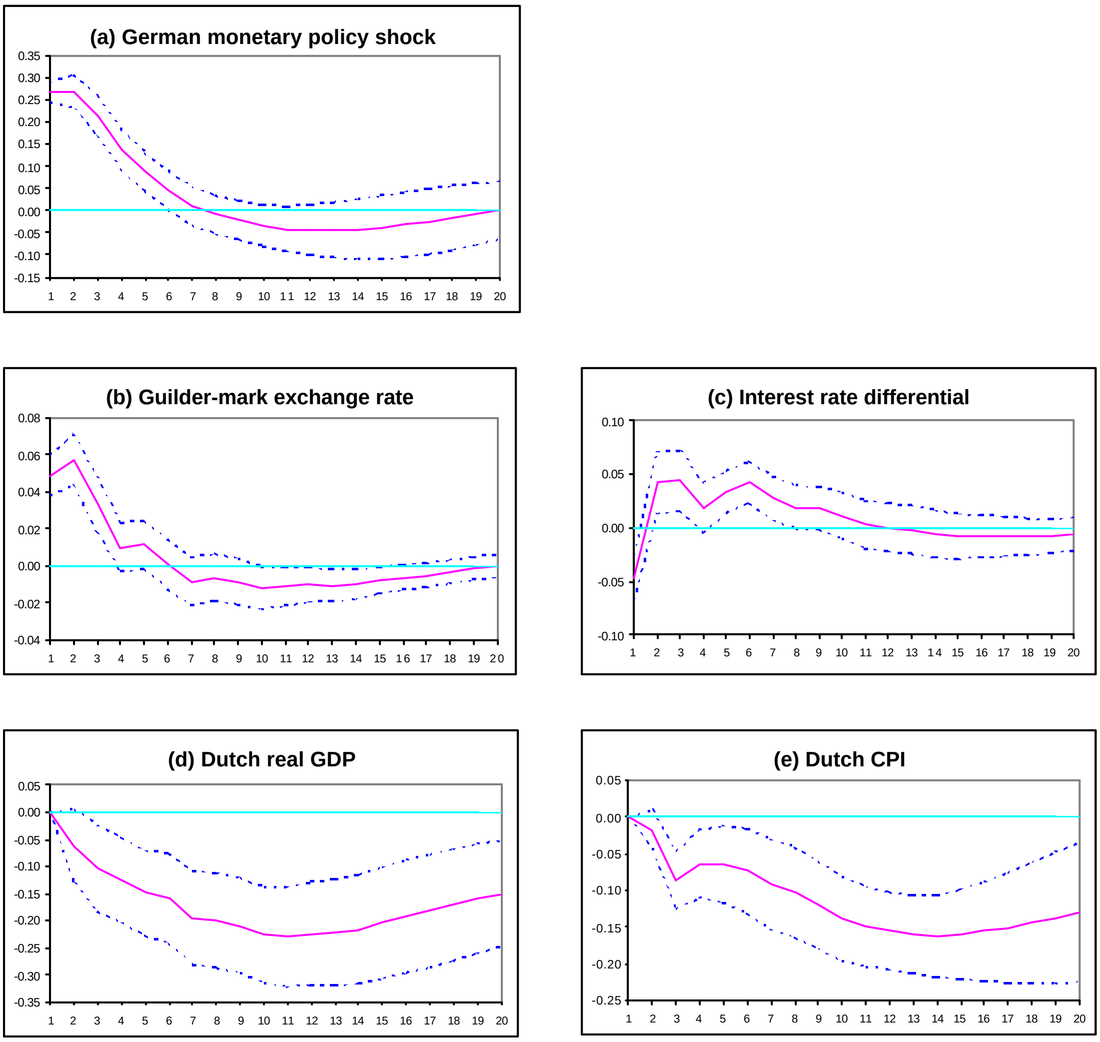


Figure 2. Dutch monetary policy shock and its effects on the Dutch economy

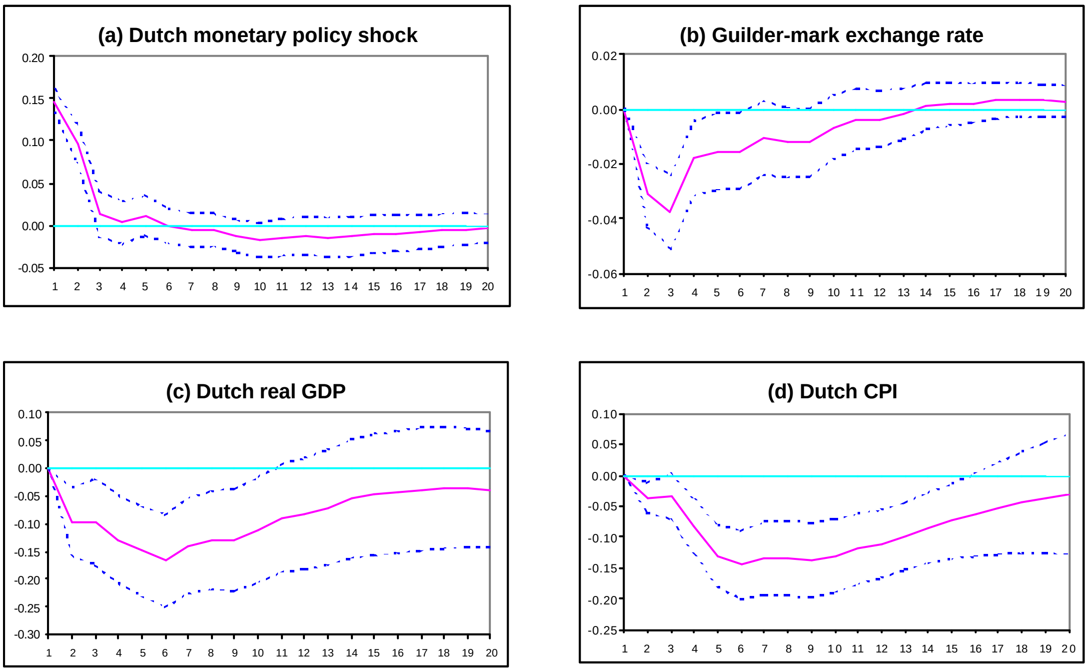


Figure 3. Responses of private sector wages to German and Dutch policy shocks

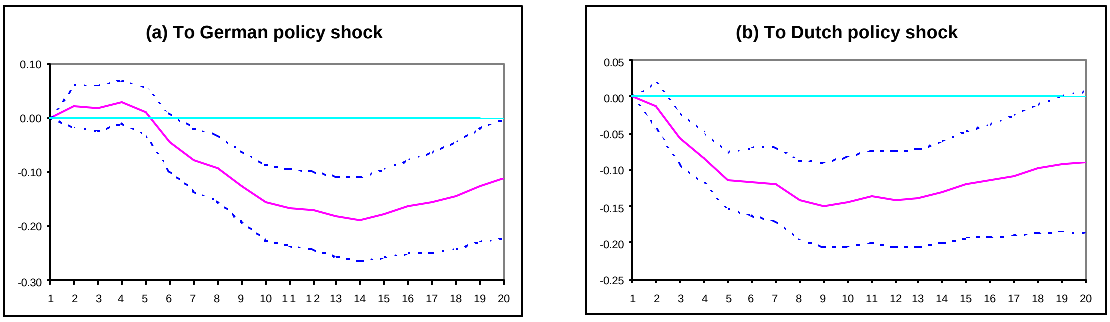
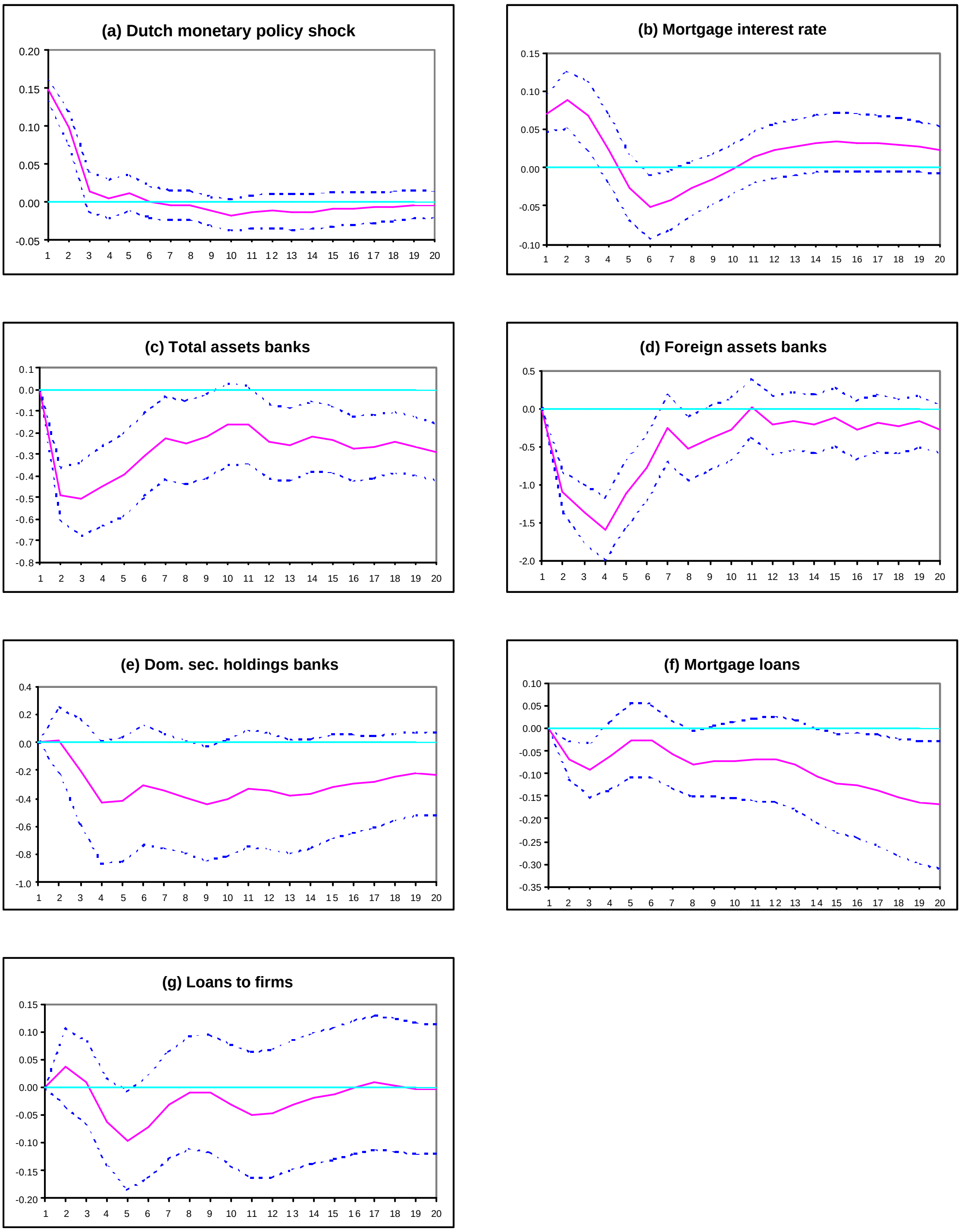


Figure A1. Dutch policy shock and its effects on the Dutch banking sector



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